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Network Analysis Report

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Purpose

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I – Abstract:

This report focuses on the transition of aviation hub from Karachi to Dubai in the recent times. The comparison of relations among members of aviation industry, more specifically Karachi and Dubai, in the current era and the last quarter of twentieth century. To analyze the factors of aviation hub transition in South-Asia is one of the primary objectives of this research. Moreover, the research also focuses on the effects of this transition in the economy of both the egos (Karachi and Dubai).

II – Introduction:

Aviation industry plays a vital role in the development of country's economic sector. The number of flights of an international airline of a certain country contributes a major part in the foreign relations of that country. This phenomenon is primarily inter-related with the country's political and security trends and of course how these relations are put into words by the foreign policy administrators. To analyze the trends in foreign relations as a social network with respect to the aviation industry gives rise to an airline network which is a visual representation of how the airline hub transition in South-Asia happened after 2000 AD. To study the contribution of then political and development scenarios in the shifting of airline hub and to examine the reasons behind this phenomenon will be the center point of analysis in the following discussion. The hypothesis on which we will be working is that after 2000 AD, there occurred a major change in the aviation sector of Karachi. Established and renowned airlines ceased their traffic flow from Karachi and diverted the flow of flights to Dubai making Dubai International Airport the hub of connecting flights and the center of all aviation business activities in South-Asian region.

III – Methodology:

Airport network is more of an ego-centric network in which the analysis revolves particularly around the city or airport under consideration. The surveys or questionnaires were not the relevant means of data collection for the kind of research we chose. We had two options, either to meet the relevant authorities of Jinnah International Airport in person and gather data for at least the flights of Karachi or the other option was to research for the data online. We were able to find the relevant information online hence the methodology adopted for data collection was mainly based on online research. Relevant websites were surfed in order to gather the data of flights at respective airports. In some cases, the websites of airlines provided the necessary information while in other cases the reliable websites were searched. In our analysis, the connecting flights are also put into consideration with the end node being one of our egos i.e. Karachi or Dubai.

IV – Domain Restriction:

In order to keep things simple and organized, the authors decided to restrict the research boundary to eight airlines namely British Airways, Pakistan International Airlines, Turkish Airlines, Emirates, Qatar Airways, Air France, Lufthansa and Etihad Airways. Moreover, seventy important airports all around the world were taken as nodes inclusive of Karachi and Dubai which act as destination nodes in an airline network directed graph. Moreover, the arcs (directed edges) in the network are weighted. The weights represent the number of flights being made from one city to another in a week. So our directed graph's entities are mentioned below in a summarized format.

Nodes	→ Cities
Arcs (directed edges)	→ Flight made from one city to another
Egos	→ Karachi and Dubai
Weight of arcs	→ No. of flights made in a week

V – Analysis:

Since our project is comparing the past with the present, we will analyze the historic events in a step by step manner. In 1980s although Pakistan was not governed by a democratic government but still the economy and foreign relations were in a stable position and the development continued. The impact of progressive aviation sector in Pakistan was also observed at Jinnah International Airport and the airlines considered Karachi as the hub of their connecting flights in South-Asian region. Side by side Dubai was being developed and progressed. This impacted Dubai International Airport's traffic in a positive manner and according to our researched data, Dubai and Karachi were almost at the same *proximity prestige* for the airline companies in 1980s.

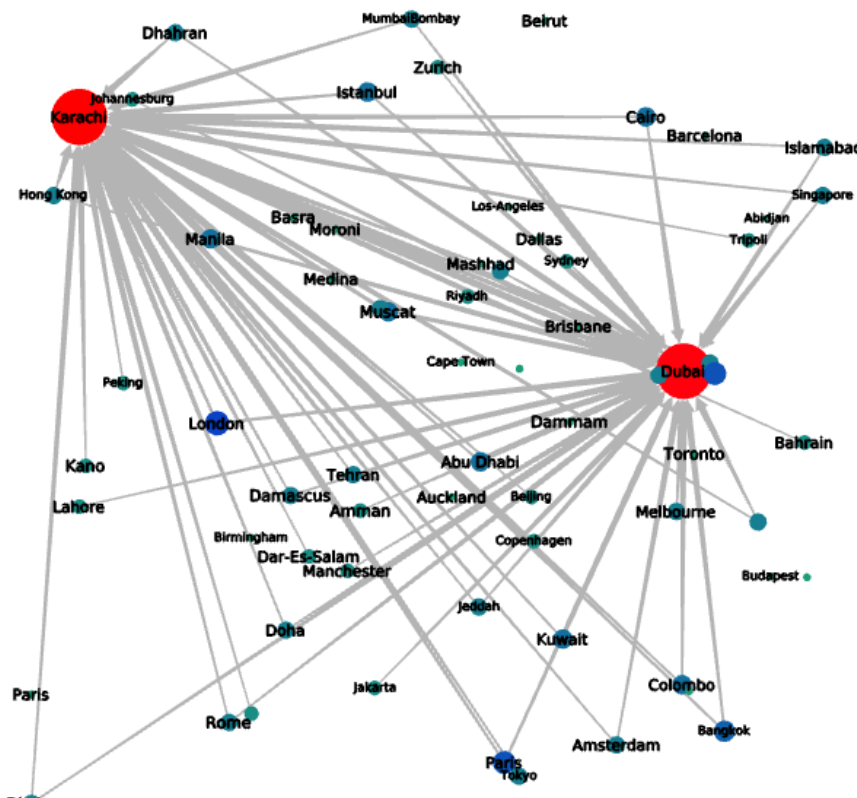


Figure 01: Incoming flights to Karachi and Dubai between 1980 and 2000

The years following after 1990 exhibited approximately the same behavior in airline network but during 1990s, the seed for the security and political mishap had been sown which showed its

impacts in the late 1990s i.e. close to 2000. The flights still continued to fly from Jinnah International Airport and it still remained the hub of connecting flights along with Dubai at least till the late 1990s.

1.	49	- Dubai
2.	0	- Kuwait
3.	0	- London
4.	0	- Colombo
5.	0	- Muscat

Figure 02(a): Degree Centrality of Dubai
Between 1980 and 2000

64.	0	- Mashhad
65.	0	- Abidjan
66.	0	- Adelaide
67.	0	- Sydney
68.	50	- Karachi

Figure 02(b): Degree Centrality of Karachi
between 1980 and 2000

In a comparison of ego-centric network like this, the simplest and one of the best approaches to analyze the network is to calculate the *degree centrality*ⁱⁱ on each ego and then compare the results against one another. Since we are analyzing the number of flight landings in Karachi and Dubai so an “in-degree” centrality analysis is done. After the network analysis, it was found that Karachi and Dubai had almost the same in-degree centrality during the 1980 – 2000 era.

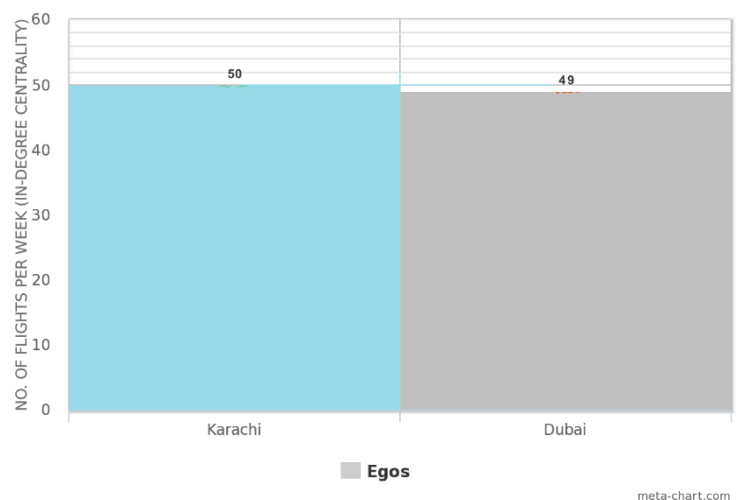


Figure 03: Histogram showing in-degree centrality for Karachi and Dubai between 1980 and 2000

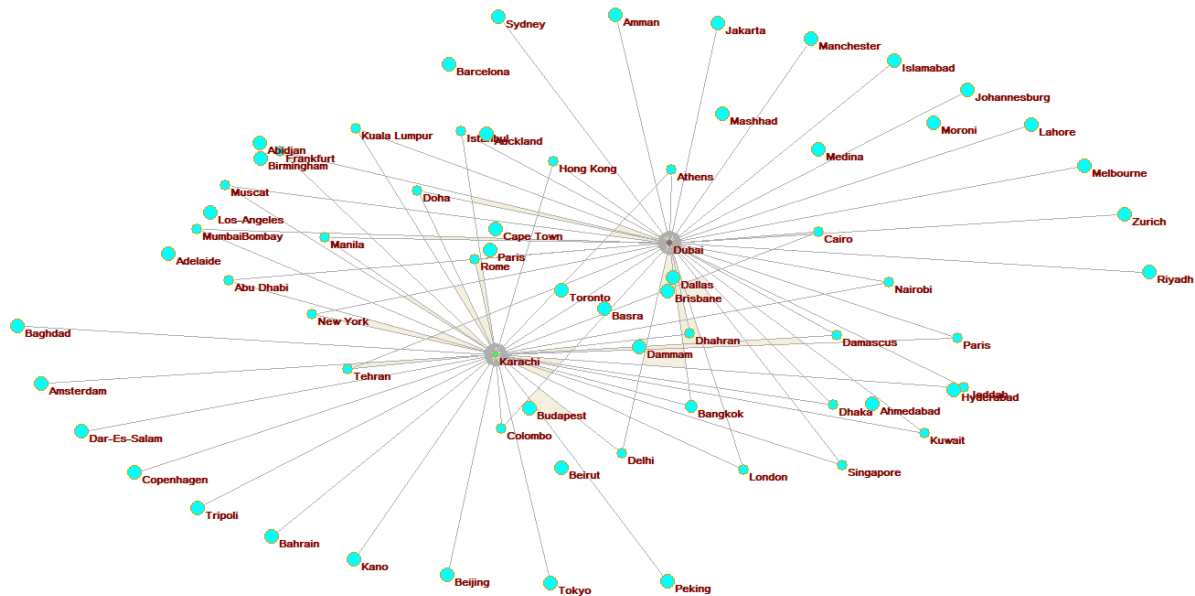


Figure 04: Airline network showing number of flights per week between 1980 and 2000

The network embodied in itself many *structural holes*ⁱⁱⁱ and it was studied that *bridges*^{iv} do exist in such an airline network. There were many instances found in our initial research process where the cities were not directly linked to each other. The link between them was established via a hub. Figure 04 shows dominance of hubs in an airline network. Moreover, the extent of structural hole is mapped as the size of nodes. The larger the size of a node, the lesser the connections it has. With this we sum up our discussion on the last quarter of 20th century (1980 – 2000 AD).

The later portion of our discussion emphasizes upon the reasons, events and factors which disturbed Karachi's setting as a hub in South-Asian region.

In 1999, the political scene in Pakistan experienced a critical change when the civilian democratic government was overruled by the established military rule. This event had a vital impact on the politics as well as on the security (initially) of Pakistan. The change also reflected on Karachi as, apart from agriculture, Karachi is the leading producer of economy for Pakistan. The internal political scenarios and its relative effect on the foreign policies were not acceptable by the airline companies and so initially they decided to decrease the number of landings for connecting flights in

Karachi; keeping in mind, Dubai International Airport was still an alternative node for airlines. The political discrepancies had not been to a halt yet, another pivotal event (9/11; World Trade Center attacks) occurred in 2001 after which the voices were raised regarding the existence of terrorist hubs in Pakistan. Soon after, British Airways ceased its flight operations in Karachi (and all over

Pakistan). Lufthansa had already boycotted its landings in Karachi. These events were soon followed by the news of Air France announcing its alternative route from Dubai International Airport which meant that Jinnah International Airport had lost another huge airline to land its flights in Karachi. Other than that, some airlines reduced the number of flight landings in Karachi.

The flow of air traffic was diverted from Jinnah International Airport to Dubai International Airport in this part of Asia. This was the time when United Arab Emirates,

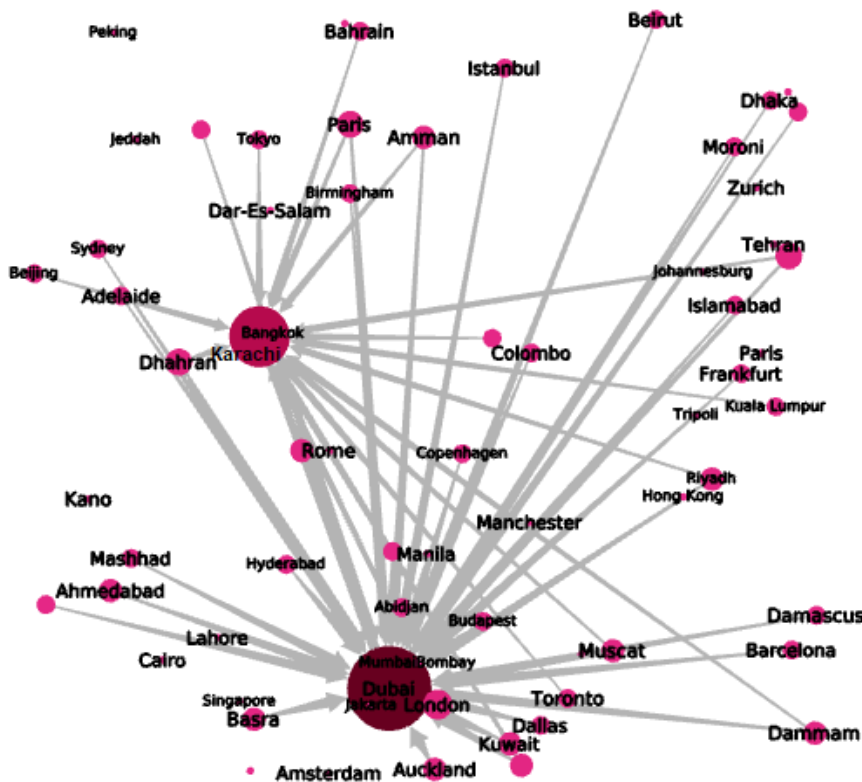


Figure 05: Incoming flights to Karachi and Dubai between 2000 and 2017

particularly Dubai was at the peak of development. Mega development projects were being planned and initiated in Dubai. The creation of Palm Islands in Dubai was also started in 2001. Dubai was progressing in the fields of tourism and mega-structure developments. Construction of Burj Khalifa was also started in 2004. Dubai Marina was also established in 2003. In short, the massive development projects were all planned and initiated after year 2000. The stable development scenarios in Dubai and long-lasting security and political circumstances in Karachi all led to a secure and steady progress of aviation industry in Dubai. Such huge development projects and stability in international oil market inspired airline companies and soon Dubai International Airport became the center and hub of aviation activities in this part of Asia. This in turn knocked the door of progress at Emirates and now it is one of the top 10 airlines in the world. One argument here is really important to be made that the industrial and economical down grading in Pakistan and its impact on the reduction of airlines coming to Pakistan is evident from the current situation which Pakistan International Airlines is facing in current time. Figure 05 shows the clear visual of lack of interest of airlines in Jinnah International Airport.

1.	46	- Dubai
2.	0	- Kuwait
3.	0	- London
4.	0	- Colombo

Figure 06(a): Degree Centrality of Dubai
Between 2000 and 2017

65.	0	- Abidjan
66.	0	- Adelaide
67.	0	- Sydney
68.	21	- Karachi

Figure 06(b): Degree Centrality of Karachi
between 2000 and 2017

The same kind of analysis can be done on the network of 2000- 2017. According to our researched data, it was found that Karachi's degree centrality has vitally been decreased. Karachi, which was the hub of airlines in late 20th century, is no more a centric node now. The air traffic has been diverted towards the Middle East, the developed sector.

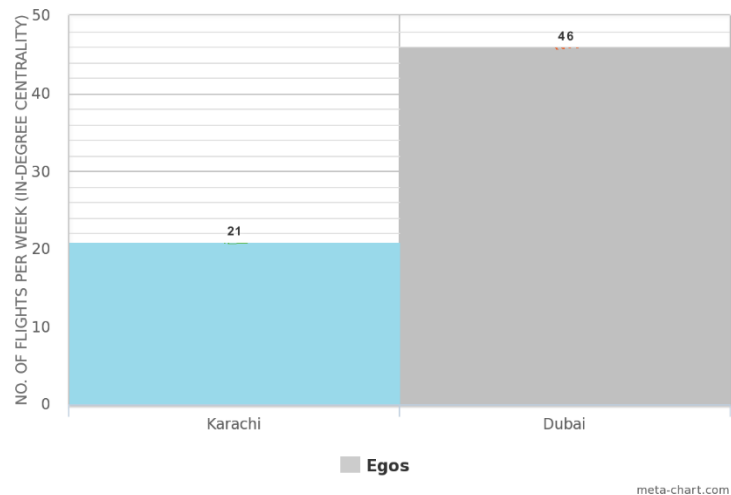


Figure 2: Histogram showing in-degree centrality for Karachi and Dubai between 2000 and 2017

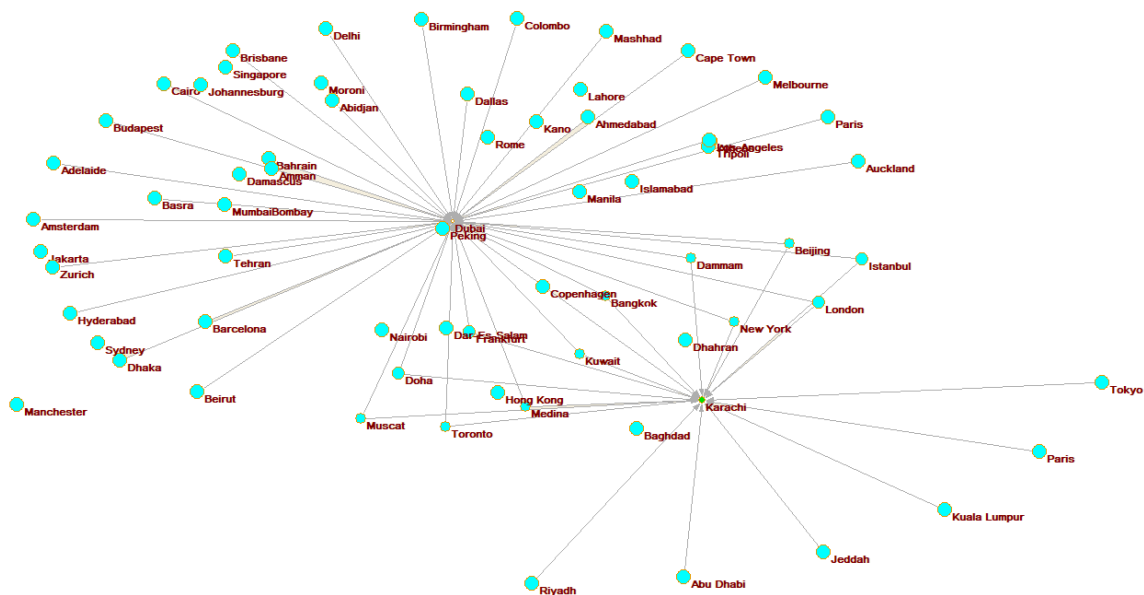


Figure 08: Airline network showing number of flights per week between 2000 and 2017

VI – Difficulties in Data Collection:

Data is vast but polluted. Although the online web surfing provided data for our research but the purification of data was a huge task. The data we were able to find was scattered and noisy. The integration of this scattered data after purifying and extracting knowledgeable information out of it was really time-taking. Moreover, we have also scaled the data based on certain calculated assumptions. For instance, there were some years in both the phases (first phase: between 1980 and 2000, second phase: between 2000 and 2017) which we couldn't find appropriate data of. But we also used those years in our research analysis as well by looking at the preceding and succeeding years and finding out approximate the same trend in number of flights being made. We assume this strategy being fair in favor of our analysis because if that wasn't being done, the continuity and flow of year by year analysis was being disturbed and interrupted.

The authors believe that a much more refined data could have been gathered. Instead of relying completely only on the online resources, we could have interviewed some personnel from management at Jinnah International Airport. The proposed solution could not be achieved by us as we were unable to establish warm contacts who could give us access to the airline data.

X – Conclusion:

The aviation industry throughout the globe has advanced in numerous ways. One of these is the redefinition of secure and economical air routes. According to our research and in the lights of above presented statistical data, it can be concluded that Karachi and Dubai were almost at the same prestige status in airline network back in 1980s. Renowned airlines considered Karachi and Dubai at almost equal rank and both the cities were used as hub for connecting flights in the South-Asian region. A decade and a half later, both the cities experienced major changes in terms of economy and politics. Dubai started growing its roots in tourism sector and mega development projects were being planned on the lands of Dubai. Opposed to that, Karachi was at the verge of crucial security and economic crisis. All this resulted in the good and progressive impact of Dubai on airline companies while on the other hand, the image of Karachi was vitally damaged. Hence huge airline companies for example Air France, British Airways and Lufthansa abandoned their flights to Karachi and shifted the fulcrum of their attention in favor of Dubai while some of them reduced the number of landings on Jinnah International Airport. Therefore, in current time Dubai is enlisted in one of the busiest airports in the world. The reasons and arguments to that are already presented in detail above.

VII – Online Sources:

Following are online sources we used for the collection of airline network data.

1. <http://www.airlineroutemaps.com/maps/PIA Pakistan International Airlines>
2. <https://ey.fltmaps.com/en>
3. <https://www.airfrance.us/travel-guide/destinations-map>
4. <http://routemap.emirates.com/english#flights>
5. [http://onw.innosked.com/\(S\(ydqx42z1b2yfyxhj4o2g2b\)\)/default.aspx?show=MAP](http://onw.innosked.com/(S(ydqx42z1b2yfyxhj4o2g2b))/default.aspx?show=MAP)
6. https://www.britishairways.com/travel/where-we-fly/public/en_gb/map
7. <https://www.fivestaralliance.com/luxury-hotel-experts/qatar-airways-0>
8. <https://lh.fltmaps.com/mobile/en/SearchRoutes>
9. <http://www.flightconnections.com/>

VIII – Tools Used:

Following are the tools used for analysis and visuals throughout the project.

1. For Analysis:
 - Pajek 5.01
 - Tulip 5.0.0
2. For Visuals:
 - Pajek 5.01
 - Tulip 5.0.0
 - <https://www.meta-chart.com/histogram>

IX – Acknowledgement:

A special gratitude we give to our final project mentor, Dr. Shah Jamal Alam, whose contribution and continuous feedback helped us to complete our research project.

Furthermore, we would also like to acknowledge the support of Ms. Fatin Nawaz, the teaching assistant for CS261 – Understanding Social Networks, for guiding us through the process of data collection.

End Notes:

ⁱ The number of direct connections a node possesses.

ⁱⁱ The count of the number of ties that a node directs.

ⁱⁱⁱ The absence of an edge between two nodes.

^{iv} An edge which if removed increases the count of number of components in a graph.